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ENTHALPY AND HEAT CAPACITY OF MOLYBDENUM IN THE
1200-2500°K TEMPERATURE RANGE

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ENTHALPY AND HEAT CAPACITY OF MOLYBDENUM
IN THE 1200-2500°K TEMPERATURE RANGE

L. S. Lazareva, P. B. Kantor and V. V. Kandyba

This article cites the results of an experimental determination of the enthalpy of molybdenum in the 1164-2540°K range with an error of less than 1%.

The literature data [1, 3] concerning the experimental determination of the enthalpy and heat capacity of molybdenum at elevated temperatures is very scanty. Most of the data is limited to a comparatively low upper limit of 1400°K; the accuracy of determining the heat capacity is about 5%.

Our measurements were based on the method of coalescence in a high-temperature vacuum device [4, 5].

A vertical electric resistance furnace with a graphite heater surrounded by a number of coaxial screens of heat-resisting materials was used for heating the test specimens.

The temperature of the specimen was measured by an OP-48 standard optical pyrometer [6]. The corrections for absorption by the rotating prism, the vacuum window, and other parts were determined by a special calibrated temperature tube, which was installed in the furnace at the site of the ampule.

The error in the temperature measurement did not exceed 0.1-0.5% in the 1000-2500°K range.

After heating, the test-specimen ampule dropped into a receiving vessel, which was installed in the cavity of a massive block. The metallic block was contained in an air-tight vessel connected to the vacuum system of the device. The entire system from the furnace to the calorimeter (pre-evacuated) during measuring was filled by argon at a pressure of 12-14 mm Hg.

The heat-control system assured a constant temperature of the block within an accuracy of 0.002°.

The temperature rise of the calorimeter was measured within an accuracy of 0.001°C (by a five-decade thermometric bridge and a 100-ohm platinum resistance thermometer placed on the side face of the aluminum block).

The specimens were made of molybdenum sheet 0.2 mm thick (produced by the Moscow Hard Alloys Plant). The impurity content was 0.02% (mainly molybdenum oxides), in addition to traces of nickel and silicon.

The weight of the specimens (50 g) remained constant within an accuracy of hundredths of a per cent. The surface of the ampules after the experiments was still lustrous, thus attesting to the purity of the argon in the furnace.

The heat content of the "empty" ampules was predetermined in order to exclude an error resulting from heat losses of the specimen when it is dropped into the calorimeter.

The enthalpy of the molybdenum was measured in the 1154-2462°K range. The experimental data obtained, reduced to a temperature of $T = 298.16$ [7], are given in Table 1.

From these experimental data, which were treated by the method of least squares, we found the coefficients of the equations:

$$H_T - H_{298.16} = 4.981\ T + 8.795 \cdot 10^{-4}\ T^2 - 1460 \text{ cal/g} \cdot \text{atom.} \quad (1)$$

$$C_p = 4.981 + 17.59 \cdot 10^{-4}\ T \text{ cal/deg. g} \cdot \text{atom, } (1150 - 2500°\text{K}). \quad (1a)$$

TABLE 1

T°, K	$H_T - H_{298.16}$, cal/g · atom	T°, K	$H_T - H_{298.16}$, cal/g · atom	T°, K	$H_T - H_{298.16}$, cal/g · atom	T°, K	$H_T - H_{298.16}$, cal/g · atom
1154	5509	1575	8556	1990	11917	2175	13531
1179	5645	1603	8789	2016	12220	2200	13817
1224	5998	1666	9250	2025	12262	2208	13903
1241	6098	1683	9365	2045	12450	2229	14081
1263	6266	1723	9787	2047	12501	2261	14291
1292	6438	1773	10151	2059	12562	2275	14368
1295	6504	1822	10483	2066	12570	2293	14606
1298	6543	1826	10499	2068	12632	2295	14584
1338	6717	1829	10597	2070	12665	2328	14962
1358	6905	1839	10624	2072	12635	2370	15275
1423	7424	1843	10727	2082	12694	2392	15429
1478	7830	1865	10900	2106	13011	2408	15548
1479	7810	1913	11237	2125	13183	2412	15827
1525	8220	1928	11495	2150	13279	2458	16041
		1970	11821			2462	16150

The standard deviation of determining the coefficients of the equation is 0.4%.

The standard deviation of determining the enthalpy is between 0.3 and 1.1% in the 1000-2500°K range.

A comparison of the data we obtained for the heat content with the results of other studies is given in Table 2.

The deviation of our data from Kelley's results [2] for 1100-1300°K is 1-2%.

The value of C_p in Redfield's study [1] is assumed to be constant up to 1300°K

and is about 10% lower than our data.

TABLE 2

T°, K	C_p cal/g · atom · deg	C_p cal/g · atom · deg (Kelley)	C_p cal/g · atom · deg (Redfield, et al)
1100	6.917	6.889	6.477
1200	7.093	7.014	6.477
1300	7.264	7.1397	6.477
1400	7.445	-	-
1500	7.620	-	-
1600	7.796	-	-
1700	7.972	-	-
1800	8.148	-	-
1900	8.324	-	-
2000	8.500	-	-
2100	8.676	-	-
2200	8.852	-	-
2300	9.028	-	-
2400	9.204	-	-
2500	9.380	-	-

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REFERENCES

1.   REDFIELD, T. A. and HILL, I. H. U. S. Atomic Energy Comiss. ORNL, 1951, 24, Sept., 1087.

MCL-1243/1

2. KELLEY, K. K. Bureau of Mines Bull., 1949, 476.

3. KOTHEN, C. and JONSON, N. L. Bull. Chem. Termod., 1960, No. 3.

4. KANDYBA, V. V.; KANTOR, P. B.; KRASOVITSKAYA, R. M. and FOMICHEV, Ye. N. Doklady Akad. Nauk SSSR (Reports Acad. Sci. USSR), 131, 3, 1960.

5. KANTOR, P. B.; KISEL', A. N. and FOMICHEV, Ye. N. Ukr. Fiz. Zhurn. (Ukrain Phys. J.), 5, 3, 358, 1960.

6. KANDYBA, V. V. Zav. Lab. (Factory Lab.), 1, 1956.

7. SIMON, C. Zs. phys. Chem., 1926, 129, 383.